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EXAMPLE 11

Conversion of Sorbitol in [OMIM]Cl

No Metal Halide Catalyst

50 mg sorbitol and 500 mg [OMIM]Cl were introduced to a vial. The vial was installed into a high pressure reactor, evacuated, purged with N₂. The vial was shaken at 700 rpm and heated at 150° C. under 25-torr vacuum for 1 h. The vial was cooled and 2.0 mL water was added for analysis by HPLC. Conversion of sorbitol was 97.2%, yield of 1,4-sorbi-

EXAMPLE 12

Conversion of Sorbitol in [OMIM]Cl

CuCl₂ Metal Halide Catalyst

Sorbitol was processed as in Example 9 in [OMIM]Cl with 50 mg CuCl₂ added as catalyst. Conversion of sorbitol was 95.8%; yield of 1,4-sorbitan was 36.3%; and yield of isosorbide was 37.3%.

EXAMPLE 13

Conversion of Sorbitol in [EMIM]CH₃SO₃

No Metal Halide Catalyst

Sorbitol was processed as in Example 9 in [EMIM]CH₃SO₃. Liquid products were analyzed by HPLC. Conversion of sorbitol was 82.4%; yield of 1,4-sorbitan was 63.8%; yield of isosorbide was 1.6%.

EXAMPLE 14

Conversion of Sorbitol in [EMIM]Cl

ZnCl₂ Metal Halide Catalyst

Sorbitol was processed as in Example 9 in [EMIM]Cl with 50 mg ZnCl₂ added as catalyst. Products were analyzed by HPLC. Conversion of sorbitol was 92.1%; yield of 1,4-sorbitan was 76.0%; yield of isosorbide was 3.8%.

Results of Examples 11-14 are summarized in TABLE 5.

TABLE 4

Conversion of Sorbitol, and product yields.				
Ex- am- ple	Feedstock	Ionic Liquid and Catalyst	Feedstock conversion (%)	Product yields (%)
11	Sorbitol	IL: [OMIM]Cl, Catalyst: None	97.2	1,4-sorbitan: 51.6 Isosorbide: 20.0
12	Sorbitol	IL: [OMIM]Cl, Catalyst: CuCl ₂	95.8	1,4-sorbitan: 36.3 Isosorbide: 37.3
13	Sorbitol	IL: [EMIM]CH ₃ SO ₃ , Catalyst: None	82.4	1,4-sorbitan: 63.8 Isosorbide: 1.6
14	Sorbitol	IL: [EMIM]Cl, Catalyst: ZnCl ₂	92.1	1,4-sorbitan: 76.0 Isosorbide: 3.8

As demonstrated in Examples 11-14, sorbitol is dehydrated to products including, e.g., isosorbide and 1,4-sorbitan. Yields are selectively tunable by choices of ionic liquid and catalyst.

While Examples presented herein demonstrate conversion of carbohydrates using a single batch process and reactor, the

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invention is not limited thereto. Those of skill in the art will appreciate that many reactors and reactor configurations are suitable for use in conjunction with the invention, including, e.g., step-wise and/or serial processing, multistage processing and reactors, continuous flow processing and reactors, and/or tandem stage processing and reactors. All reactor configurations and processes as will be contemplated and implemented by those of skill in the art in view of the present disclosure are within the scope of the invention.

While preferred embodiments of the invention have been shown and described herein, many changes and modifications may be made without departing from the invention in its broader aspects. The appended claims are therefore intended to cover all such changes and modifications as fall within the scope of the invention.

We claim:

1. A method for selective conversion of a fructose to produce a furan, said method comprising the steps:

mixing fructose up to a limit of solubility with an ionic liquid, said ionic liquid a 1-R₁-3-R₂-imidazolium chloride, where R₁ and R₂ are alkyl groups of formula (C_xH_{2x+1}) where X=1 to 18; and

heating said fructose in the presence of a metal halide catalyst at a reaction temperature and a reaction time sufficient for conversion of same.

2. The method of claim 1, wherein said metal halide is selected from the group consisting of AlCl₃, CrCl₂, CrCl₃, FeCl₂, FeCl₃, CuCl, CuBr, CuCl₂, CuBr₂, VCl₃, MoCl₃, PdCl₂, PtCl₂, PtCl₄, RuCl₃, RhCl₃, and combinations thereof.

3. The method of claim 1, wherein said reaction temperature is about 80° C. and said reaction time is between about 1 hour and about 4 hours.

4. The method of claim 1, wherein conversion of fructose is greater than or equal to about 80 percent and said yield of said furan is greater than or equal to about 50 percent on a mole basis.

5. The method of claim 1, wherein said yield of said furan is at least about 35 percent by weight.

6. The method of claim 1, wherein yield of levulinic acid and α-angelicalactone is less than about 3 percent by weight.

7. The method of claim 1, wherein the step of heating said carbohydrate includes a reaction time of from about 0.01 minutes to about 5 hours and a reaction temperature of from about 400° C. down to about 20° C.

8. The method of claim 1, wherein the step of heating said carbohydrate includes a reaction time and a reaction temperature of between about 0.01 minutes at about 250° C. and about 12 hours at about 20° C.

9. A method for selective conversion of a carbohydrate to produce a furan, said method comprising the steps:

mixing said carbohydrate up to a limit of solubility with an ionic liquid; wherein said ionic liquid includes a cation of chemical formula 1-R₁-3-R₂-imidazolium where R₁ and R₂ are alkyl groups of formula (C_xH_{2x+1}) where X=1 to 18, and an anion; said anion selected from the group consisting of methanesulfonate and trifluoromethanesulfonate; and

heating said carbohydrate in the presence of a catalyst at a reaction temperature and a reaction time sufficient for conversion of same.

10. A method for selective conversion of a carbohydrate to produce a furan, said method comprising the steps:

mixing said fructose up to a limit of solubility with 1-ethyl-3-methylimidazolium methanesulfonate; and

heating said fructose in the presence of methane sulfonate or its conjugate acid at about 80° C. for 2 hours and about 30° C. for 12 hour.